

# TWO NEW SPECIES OF *DISCOCYCLINA* (FORAMINIFERA) FROM THE UPPER EOCENE OF ASSAM, INDIA

by B. K. SAMANTA

ABSTRACT. Two new species of the foraminiferal subgenus *Discocyclina*, *Discocyclina (D.) assamica* and *D. (D.) eamesi* are described and illustrated from Upper Eocene rocks of the Garo Hills, south-western Assam, India.

FOSSILIFEROUS Eocene rocks are well developed in the Garo Hills, south-western Assam, India, and consist of three rock units, in ascending order the Tura Sandstone formation (Lower (?)–Middle Eocene), the Siju Limestone formation (Middle–Upper Eocene), and the Kopili Shale formation (Upper Eocene). The sequence is apparently conformable. Larger foraminifera occur abundantly both in the Siju Limestone formation and in the Kopili Shale formation, and the subgenus *Discocyclina* is well represented. Along with several well-known species of *Discocyclina* s.s. described from southern Europe, Western India, and Indonesia, two new species of this subgenus are present, and are described here. Holotypes and other figured specimens are deposited in the collections of the Geology Department of the University of Calcutta (CUGD).

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## SYSTEMATIC DESCRIPTIONS

Order FORAMINIFERA

Family DISCOCYCLINIDAE Vaughan and Cole 1940

Genus DISCOCYCLINA Gümbel 1868

Subgenus DISCOCYCLINA Gümbel 1868

*Discocyclina (Discocyclina) assamica* sp. nov.

Plate 94, figs. 1–6

*Holotype.* CUGD SD46 (Pl. 94, fig. 1).

*Material.* Twenty specimens examined externally, fourteen specimens studied in equatorial section, and eleven in vertical section. No microspheric forms were observed.

*Diagnosis.* Test very thin, flat, with a small umbo surrounded by wide, thin flange. Equatorial chambers typically narrow and radially much elongated. Radial chamber walls well developed and mostly aligned in adjacent annuli. Low and long lateral chamber cavities are arranged in regular tiers.

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*Description. External characters.* Test of medium size, very thin, waferlike, usually somewhat undulating, always with a small well-defined umbo. The whole surface is covered with fine papillae which appear to be more prominent on the umbo than on the surrounding wide flange, where papillae of larger dimension occur along the trace of the annular walls, forming low concentric ridges, while the interannular spaces are covered with finer papillae. Extreme thinness of the test does not permit separation from the rock in undamaged state.

Pillars are small and subcircular in cross-section. Each is surrounded by five to seven small, polygonal lateral chambers with straight to moderately undulating chamber walls.

*Internal characters.* Equatorial section. The small, bilocular embryonic apparatus consists of round to quadrilateral protoconch and deuteroconch. The larger deuteroconch embraces about two-thirds to nine-tenths of the much smaller protoconch. Rarely, the outer wall of the embryonic apparatus is irregular.

Rectangular to spatulate periembrionic equatorial chambers generally form a complete annulus surrounding the embryonic chambers. Segment formation is very rare. Periembrionic chambers are distinctly radially elongate. Often the two principal auxiliary chambers are easily distinguishable by being tangentially elongate. Periembrionic equatorial chambers differ from the later formed equatorial chambers in having greater tangential diameter and more prominent distal arches. There are about twenty-two to thirty chambers in the periembrionic ring.

From the second annulus onwards the equatorial chambers are typically narrow and radially considerably elongated. The arrangement of radial chamber walls in adjacent annuli is generally non-alternating and this arrangement continues up to the peripheral region, where alternating chamber partitions appear side by side with non-alternating ones. Frequently the chambers are arranged in radially running colonies. The annuli are irregular both in their courses and in width. The chambers are rectangular in shape. Their radial diameter increases considerably towards the periphery, so that the radial diameter of the peripheral chambers amounts to three or four times that of the chambers near the centre. Annular walls are about 6 to 10  $\mu$  thick while the radial chamber walls are 5 to 7  $\mu$  thick. Annular stolons are regularly situated on the proximal side of the radial chamber walls. The number of radial stolons cannot be definitely ascertained. There seem to be four radial stolons in the case of alternating chambers, but the non-alternating chambers generally possess two radial stolons, one each proximally and distally.

*Vertical section.* The embryonic apparatus is small and usually flattened along the median plane, so that in some sections the roof and floor of the embryonic apparatus are parallel to each other; the length of the embryonic apparatus is about twice to four times its height. The equatorial chamber layer is very thin. The periembrionic equatorial chambers are higher than the later formed chambers. From the second annulus the height of the chambers decreases slightly for some distance; then their height remains almost constant, but near the periphery increases so that the peripheral equatorial chambers are not only much longer but also a little higher than those near the centre. Roofs and floors of equatorial chambers are 10 to 13  $\mu$  thick. Annular walls are slightly convex outwards.

Lateral chambers are arranged in regular tiers. The cavities are long and low between moderately thick roofs and floors. Between the tiers of lateral chambers, there are slightly thickened areas which resemble pillars.

*Measurements**External features*

	<i>Specimen no.</i>			
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
Diameter of test (mm.) . . . . .	9.2	9.0	11.8	8.7+
Diameter of umbo (mm.) . . . . .	0.7	1.1	0.9	0.8
Diameter of papillae ( $\mu$ ) . . . . .	25	20-45	20-45	25-40

*Equatorial sections*

	<i>Specimen no.</i>			
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
Diameter of test (mm.) . . . . .	6.2+	2.5+	2.5+	7.0+
Embryonic chambers:				
Diameters of initial chamber ( $\mu$ ) . . . . .	137×94	137×150	137×143	113×125
Diameters of second chamber ( $\mu$ ) . . . . .	250×350	275×300	312×343	237×300
Distance across both chambers ( $\mu$ ) . . . . .	263	288	325	250
Thickness of outer wall ( $\mu$ ) . . . . .	6	6	6	8
Periembryonic chambers:				
Number . . . . .	27	28	23	23
Radial diameter ( $\mu$ ) . . . . .	44-69	50	44-63	50
Tangential diameter ( $\mu$ ) . . . . .	38-50	25	38-50	31-44
Equatorial chambers:				
Near centre:				
Radial diameter ( $\mu$ ) . . . . .	75	63	38	50
Tangential diameter ( $\mu$ ) . . . . .	14-19	19	25	19
Near periphery:				
Radial diameter ( $\mu$ ) . . . . .	175	162	135	155
Tangential diameter ( $\mu$ ) . . . . .	19	17-21	16-21	16-19

*Vertical sections*

	<i>Specimen no.</i>			
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
Diameter of test (mm.) . . . . .	10.0	8.5	9.4	7.0+
Thickness at centre (mm.) . . . . .	0.675	0.6	0.775	0.6
Diameter of umbo (mm.) . . . . .	1.0	0.75	1.12	0.7
Thickness at periphery (mm.) . . . . .	0.15	0.15	0.22	0.15
Embryonic chambers:				
Length ( $\mu$ ) . . . . .	300	300	325	300
Height ( $\mu$ ) . . . . .	150	100	140	75
Thickness of outer wall ( $\mu$ ) . . . . .	7	7	9	9
Equatorial chambers:				
Height at centre ( $\mu$ ) . . . . .	20	19	20	19
Height at periphery ( $\mu$ ) . . . . .	25	25	25	25
Lateral chambers:				
Number . . . . .	9	10	12	11
Length ( $\mu$ ) . . . . .	50-63	62-75	50	63-70
Height ( $\mu$ ) . . . . .	20	19-20	13-19	13
Thickness of roofs and floors ( $\mu$ ) . . . . .	13-20	13-19	10-13	19
Surface diameter of pillars ( $\mu$ ) . . . . .	13	15-40	15-40	15-40

*Occurrence.* Holotype and other figured specimens from soft, black mudstone of Kopili Shale formation exposed in Simsong River section near Siju Artheika (25° 20' N., 90° 41' E.); the species also

occurs in hard, compact, foraminiferal limestone of the same formation in the Nala section near Kamipara (25° 30' N., 90° 12' E.), 2 miles west of Tura.

*Age.* Upper Eocene.

*Derivation of name.* After the province of Assam.

*Remarks.* This extremely thin species with strikingly narrow, radially elongate equatorial chambers and mostly non-alternating radial chamber walls in adjacent rings is different from any described species of the subgenus *Discocyclina*. It bears some resemblance to *Discocyclina tenella* Gümbel, but the inadequate description and illustrations of Gümbel's form does not permit closer comparison with it.

The most significant point regarding this new species is that the radial chamber walls in adjacent annuli are mostly aligned. Brönnimann (1945), Vaughan (1945), and Cole (1948) were of the opinion that the radial walls of the equatorial chambers in adjacent annuli are usually aligned in *Aktinocyclina*, whereas in *Discocyclina* they generally alternate. Consequently, the discovery of a species of *Discocyclina* s.s. with usually non-alternating chamber partitions is of considerable interest. In fact this Assam form is so closely similar to *Aktinocyclina radians* (d'Archiac), described and figured by Brönnimann (1945), that although these two forms can easily be distinguished from each other by external characters, they are identical in the characters of the equatorial chamber layer. If only equatorial sections are available, therefore, it is not possible to separate them. This clearly indicates that in the case of these two closely related subgenera, *Discocyclina* s.s. and *Aktinocyclina*, the arrangement of equatorial chambers in adjacent annuli has no supraspecific taxonomic value.

*Discocyclina (Discocyclina) eamesi* sp. nov.

Plate 95, figs. 1-4

*Holotype.* CUGD SD61 (Pl. 95, fig. 1).

*Material.* Twenty specimens examined externally, seventeen specimens studied in equatorial section and thirteen in vertical section. No microspheric forms were observed.

*Diagnosis.* Test of medium size, plano-umbonate with small, round granules uniformly distributed over the surface. Embryonic chambers small and bilocular. In tangential section, each pillar is surrounded by four to six open, polygonal lateral chambers with straight walls. In vertical section, striking regularity of the tiers of open, rectangular lateral chamber cavities between thin roofs and floors.

*Description. External characters.* Test of medium size and usually plano-umbonate to compressed lenticular in shape. Very often the test is saddle-shaped. Numerous, small, slightly raised, round granules are evenly distributed on the surface of the test. In the peripheral region, these granules are generally arranged concentrically.

In tangential section, each pillar is surrounded by a rosette of four to six open, polygonal, lateral chambers. Vertical walls of lateral chambers are thin and straight. The pillars are separated by a single row of these chambers.

*Internal characters.* Equatorial section. The embryonic apparatus is small and bilocular. The circular protoconch is generally attached to the inside wall of the deutoconch either tangentially or by a short peduncle. Specimens with deutoconch embracing the protoconch, except for a small part at the base, are also present. The size of the embryonic apparatus does not vary appreciably, but in shape it shows variation from perfectly circular, triangular to rectangular in equatorial section.

Periembryonic equatorial chambers always form a complete annulus in which there are about twenty-three to thirty-eight radially elongate rectangular chambers. Usually they are smaller than the later formed equatorial chambers.

The annuli are more or less regular in their courses and gradually increase in width towards the periphery. The radial chamber walls are well developed and in adjacent annuli usually alternate in position, but aligned chamber walls also occur frequently in the peripheral region. Equatorial chambers are rectangular to spatulate in shape. Annular walls are 10 to 13  $\mu$  thick and the radial walls 6 to 10  $\mu$  thick. Annular stolons are situated regularly on the proximal side of the chambers.

Vertical section. The embryonic apparatus is compressed laterally and the length is two to three times the height. Length as well as height of the equatorial chambers increases gradually towards the periphery. Roofs and floors of equatorial chambers are 13 to 15  $\mu$  thick. Annular walls are gently convex outwards.

The lateral chambers form definite tiers which are strikingly regular throughout the section. The chambers have open, rectangular cavities and thin roofs and floors. Thickened areas occur between the tiers of lateral chambers and resemble pillars. They appear to be more prominent in the umbonal region.

#### Measurements

	External features			
	Specimen no.			
	1	2	3	4
Diameter of test (mm.) . . . . .	11.9	11.5	12.7	9.8
Thickness at centre (mm.) . . . . .	1.8	2.0	1.7	1.5
Diameter of umbo (mm.) . . . . .	3.7	3.2	3.3	3.1
Thickness at periphery (mm.) . . . . .	0.6	0.65	0.5	0.4
Diameter of papillae ( $\mu$ ) . . . . .	75-125	50-100	50-100	60-125

#### EXPLANATION OF PLATE 94

Figs. 1-6. *Discocyclus (Discocyclus) assamica* sp. nov. From Singsong River section near Siju Arthea, Garo Hills. 1, External view of holotype, CUGD SD46,  $\times 5$ . 2, 5, Equatorial sections of paratypes. 2,  $\times 44$ ; 5,  $\times 22$ . 6, A part,  $\times 150$ , of the section illustrated in fig. 2, to show clearly the principle of arrangement of equatorial chambers in adjacent annuli. 3, Vertical section of paratype,  $\times 30$ . 4, Enlargement of umbonal part of fig. 3,  $\times 60$ .

#### EXPLANATION OF PLATE 95

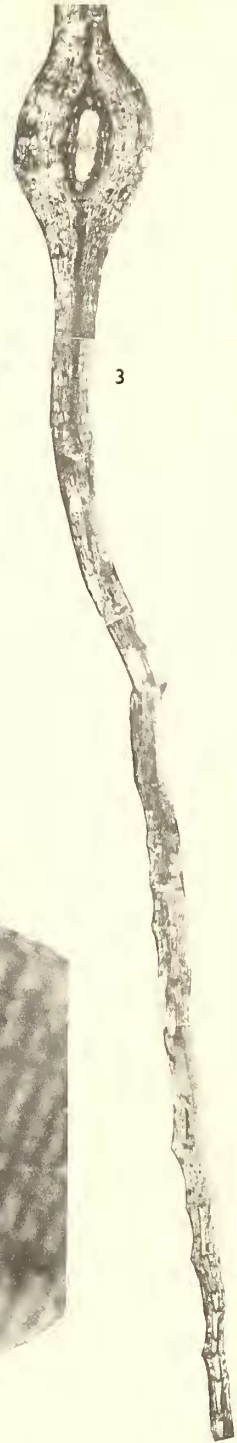
Figs. 1-4. *Discocyclus (Discocyclus) eamesi* sp. nov. From Singsong River section near Siju Arthea, Garo Hills. 1, External view of holotype, CUGD SD61,  $\times 4$ . 2, Equatorial section of paratype,  $\times 18$ . 3, Part of an equatorial section,  $\times 36$ , illustrating the embryonic chambers. 4, Vertical section of paratype,  $\times 20$ .



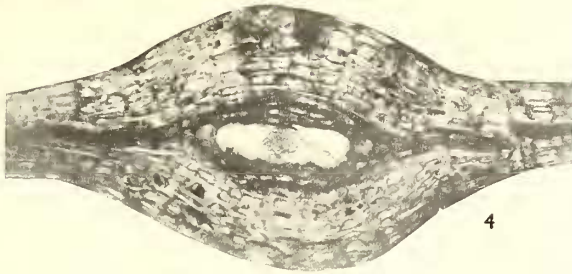
1



2



3



4



5



6

SAMANTA, Upper Eocene *Discocyclina*

